

**Panel 4 of 4**

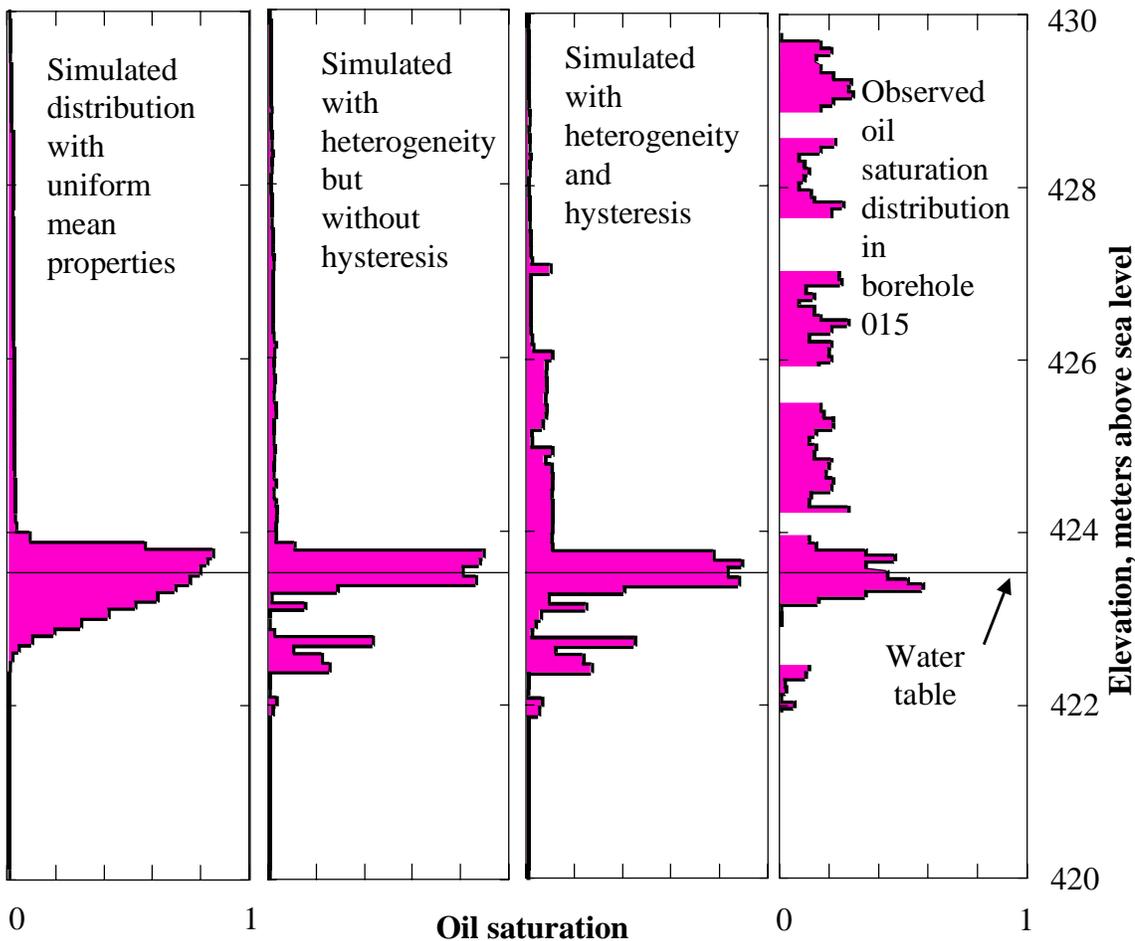
Estimating Multiphase Hydraulic Properties at a Crude-Oil Spill Site

William Herkelrath, Hedef Essaid, and Leslie Dillard

U.S. Geological Survey, Water Resources Division, Menlo Park, California

**SIMULATING THE OIL SPILL**

A cross-sectional, two-dimensional, multiphase, finite-difference flow model (Essaid et al., 1993) was used to simulate the infiltration of the oil into the unsaturated zone and the lateral spreading of the oil at the water table. Graphs of observed and simulated profiles of the oil saturation with depth in borehole 015, near the center of the spill, are shown below. Simulations run using uniform mean properties are useful, but tend to underestimate the amount of entrapment of oil in the unsaturated zone. Simulations that incorporate both the heterogeneity and hysteresis are somewhat improved, but still underestimate oil entrapment.



**SUMMARY AND CONCLUSIONS:**

Useful estimates of multiphase hydraulic properties were obtained from particle-size analysis and porosity of sediment core samples.

Reasonable simulations of the distribution of oil in the aquifer were obtained using the estimated properties.

This modeling approach tends underestimate the amount of oil remaining in the unsaturated zone.

## REFERENCES

This poster was extracted from the following two papers, which give many more details, and provide a full list of references:

Dillard, L.A., H.I. Essaid, and W.N. Herkelrath, Multiphase flow modeling of a crude-oil spill site with a bimodal permeability distribution, *Water Resources Research*, v. 33, no. 7, p. 1617-1632, 1997.

Essaid, H.I., W.N. Herkelrath, and K.M. Hess, Simulation of fluid distributions observed at a crude-oil spill site incorporating hysteresis, oil entrapment, and spatial variability of hydraulic properties, *Water Resources Research*, v. 29, no. 6, p. 1753-1770, 1993.